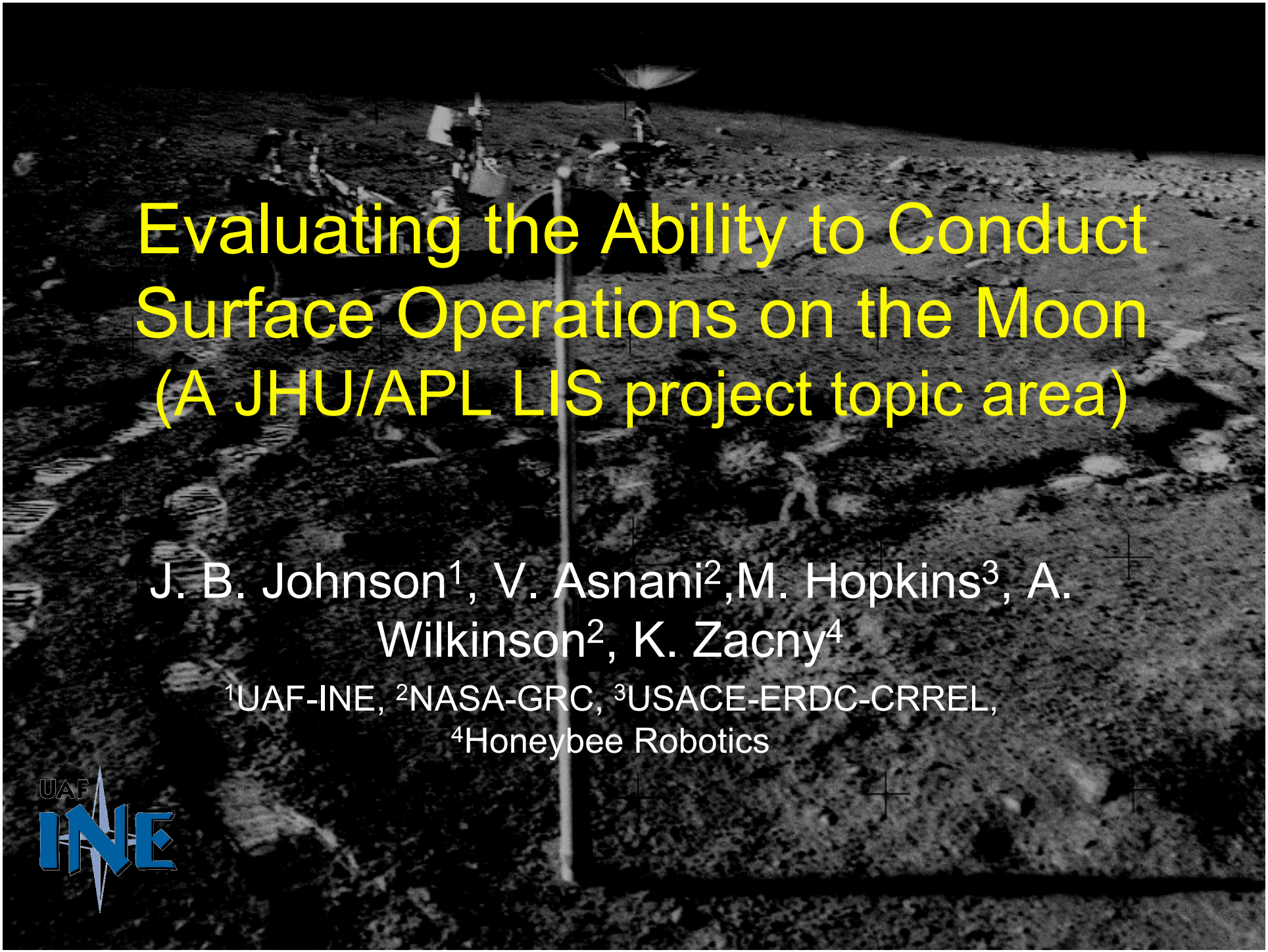

Evaluating the Ability to Conduct Surface Operations on the Moon (A JHU/APL LIS project topic area)

J. B. Johnson[1], V. Asnani[2],M. Hopkins[3], A. Wilkinson[2], K. Zacny[4]

[1]UAF-INE, [2]NASA-GRC, [3]USACE-ERDC-CRREL, [4]Honeybee Robotics

Scientific & Exploration Potential of the Lunar Poles Project

- Johns Hopkins/Applied Physics Laboratory led NASA Lunar Science Institute Funded Project (Ben Bussey - PI)
- Four science and engineering topic areas
  - Lunar Polar Environment
  - Surface Characterization
  - Surface Science, Instrumentation & Operations
    - Engineering and scientific aspects of surface operations
    - Excavation and mobility modeling
  - Education & Public Outreach

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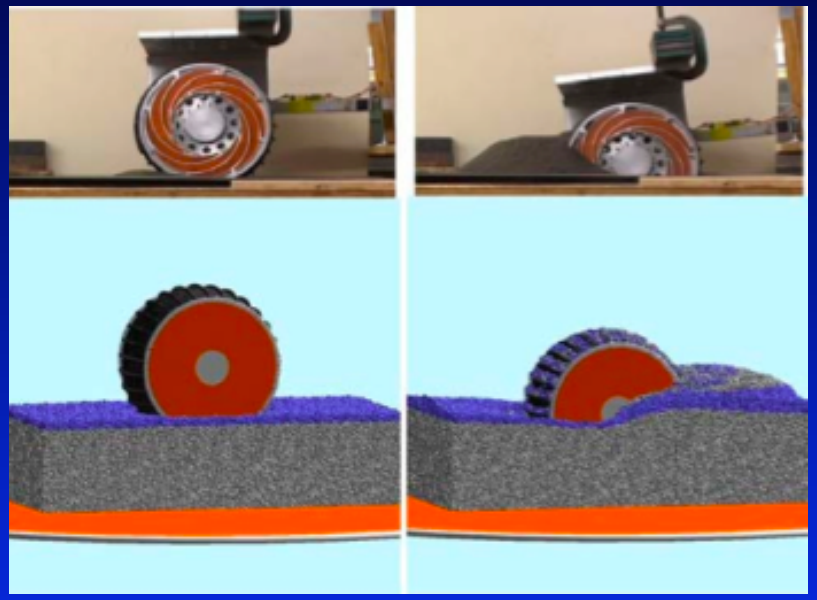
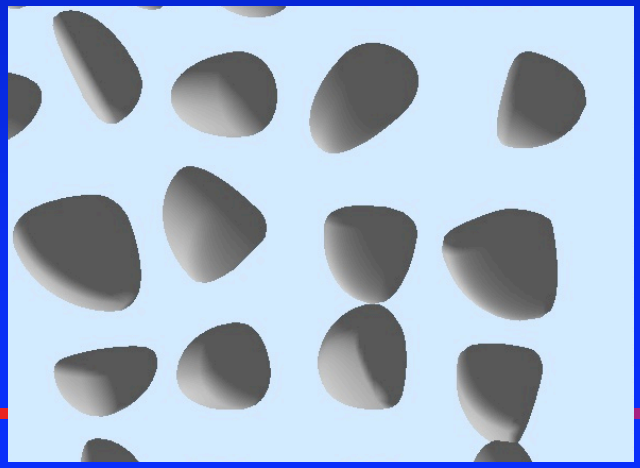
Excavation & Mobility Modeling



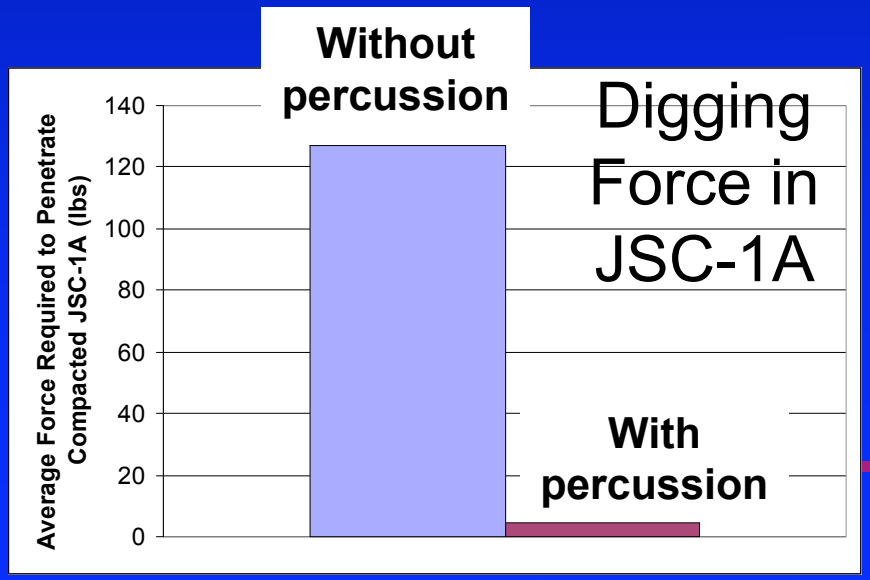


- Study regolith geotechnical properties as they relate to excavation & mobility
  - Investigate effectiveness of percussive blades & scoops
- Validate a model that can be used to simulate conditions unobtainable in a laboratory

Polyellipsoidal particles

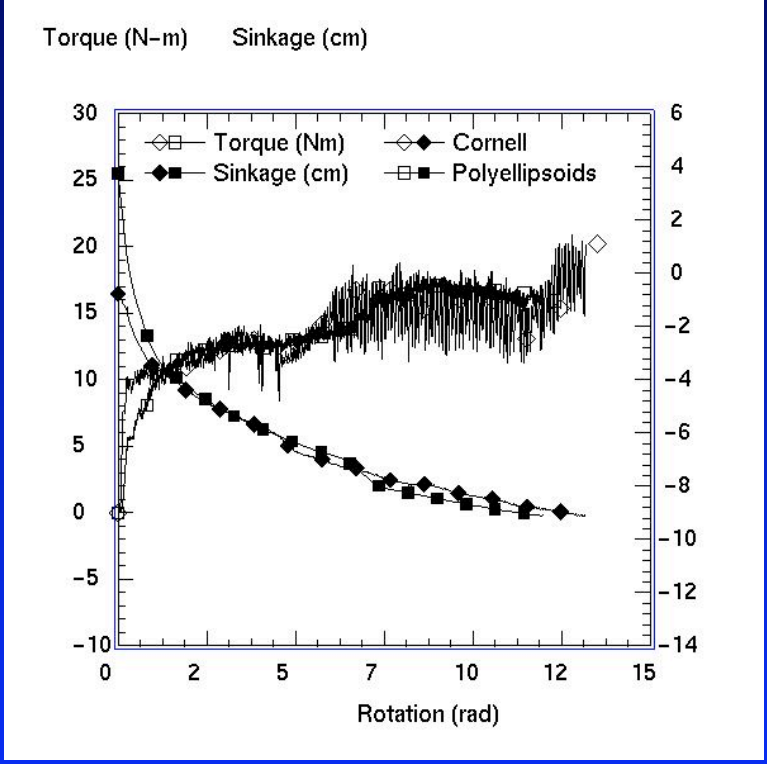
Excavation & Mobility Testing Goals

Traction testing



- Lunar regolith simulant geotechnical properties testing
- Excavation & mobility testing (under identical conditions as geotechnical tests)
  - Percussive blades & scoops
  - Mobility platforms
  - penetrometers

Excavation & Mobility Modeling DEM Development Goals



Rover wheel sinkage/torque: test results vs. simulaiton

- Validated DEM model of regolith geotechnical properties, and excavation & mobility process
  - Grain roughness, size & shape distribution
  - Grain surface cleanliness (high-vacuum)
  - Grain surface charging
  - percussive blades & scoop effectiveness

Implications for Lunar Science & Exploration Activities

- Physically based simulation tools can help:
  - Describe different complex machine/soil interactions to estimate common soil behavior (e.g., triaxial; direct shear; wheel traction/digging; penetrometer)
  - Relate Earth tests to lunar conditions
  - Design next generation equipment
  - Create virtual training environments
  - Plan future lunar surface operations
  - Interpret new lunar soil test data

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